**Politecnico di Milano**
**Scuola di Ingegneria Industriale e dell'Informazione**
Applied Statistics
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# Problem n.3

A newly designed airfoil is tested with a series of aerodynamic and acoustic tests in an anechoic wind tunnel. The file `airfoil.txt` reports the sound level (in decibel) measured under different experimental conditions characterized by different air stream frequencies (in hertz) and velocities (labelled H and L for high velocity and low velocity respectively). Consider the following linear model for the sound level ($Y$), which accounts for the air stream frequency $x$ and for the air stream velocity:

$$Y = \beta_{0,g} + \beta_{1,g} \cdot x + \epsilon,$$

with $\epsilon \sim N(0, \sigma^2)$ and $g$ the grouping structure induced by the velocity of the air stream.

a) Provide the pointwise estimates of the parameters of the model and verify the model assumptions.

b) Perform three statistical tests to verify if

- there is a significant dependence of the mean sound level on the air stream frequency,
- there is a significant dependence of the mean sound level on the air stream velocity,
- the increase in the mean sound level induced by a unitary increase in the frequency is significantly different for high and low air stream velocities.

c) Based on the results of the previous point, reduce the model and update the parameters.

d) Using the model at point c), provide a confidence interval for the mean of the sound level of a new test performed with air stream frequency of 15 000 Hz and high air stream velocity.